



Ar-Ar Studies of Lherzolithic Shergottites Yamato 000097 and 984028

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- **Yamato 000027/47/97** and **Yamato 984028** are paired - Mineralogy, chemistry, isotopes
- Concordant Rb-Sr and Sm-Nd ages of ~ 170 Ma
 - Shih et al (2010).
- Ar-Ar plateau age of Y-000097 plag is ~ 300 Ma
- Studied Ar-Ar of Y-984028 WR and pyroxene to gain better understanding of trapped Ar components in these rocks.
- Ar-Ar systematics are complicated because of multiple Ar components
- Will argue that bringing multiple data sets to bear allows distinguishing components consistent with the ~ 170 Ma age.

Lherzolic Shergottites

ALHA77005

GRV020090

Grove Mountain 99027

LEW88516

NWA1950

NWA2646

NWA4797

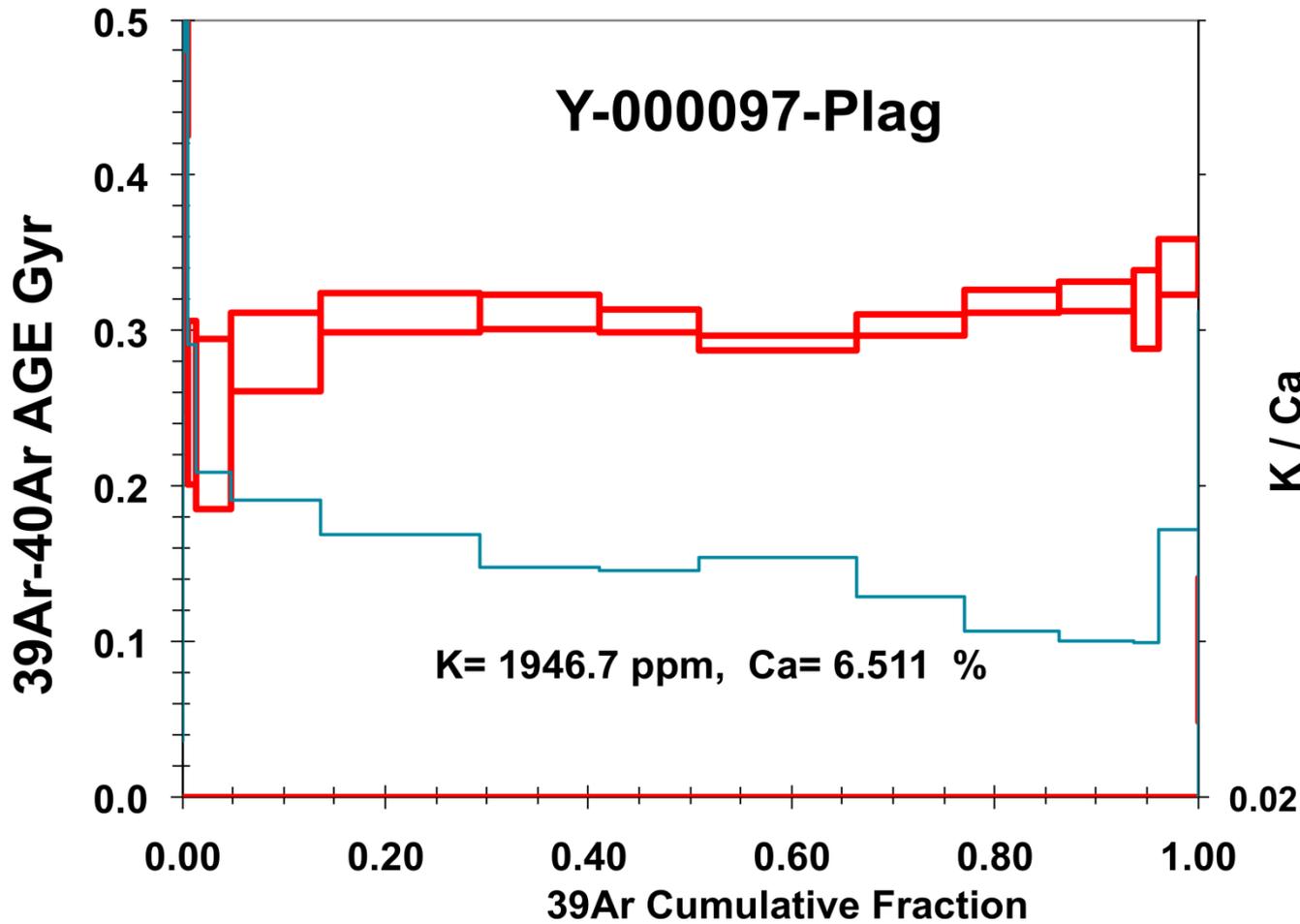
YA1075

Yamato 000027/47/97

Yamato 793605

Yamato 984028

RBT04262 (?)

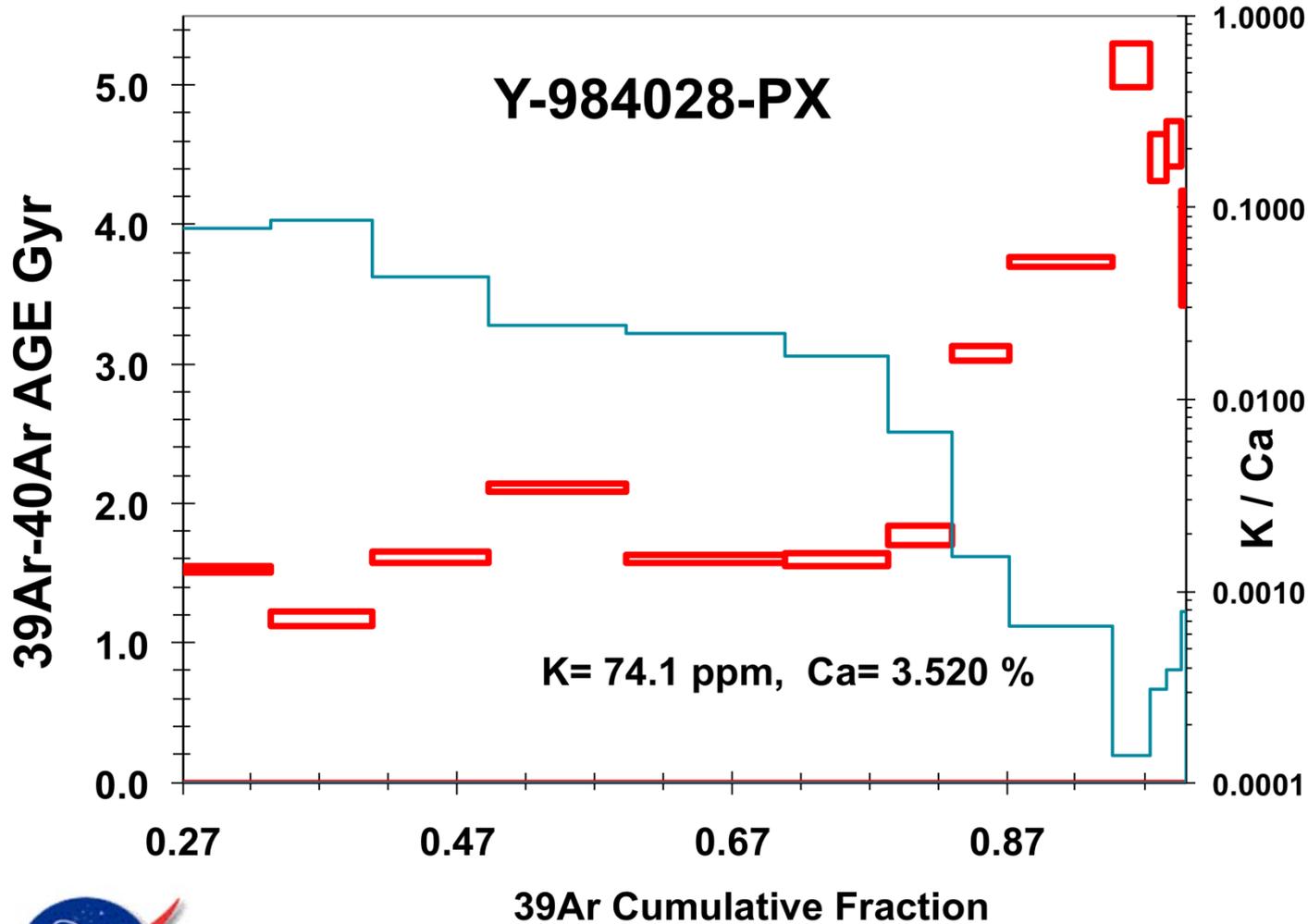


39Ar-40Ar age ~260Ma
Rb-Sr age= 147±28Ma
Sm-Nd age=152±13Ma
 (Misawa et al., 2008)

Y000097-Plag shows trapped 40Ar, similar to other shergottites.

No/little evidence for Martian atmospheric Ar.

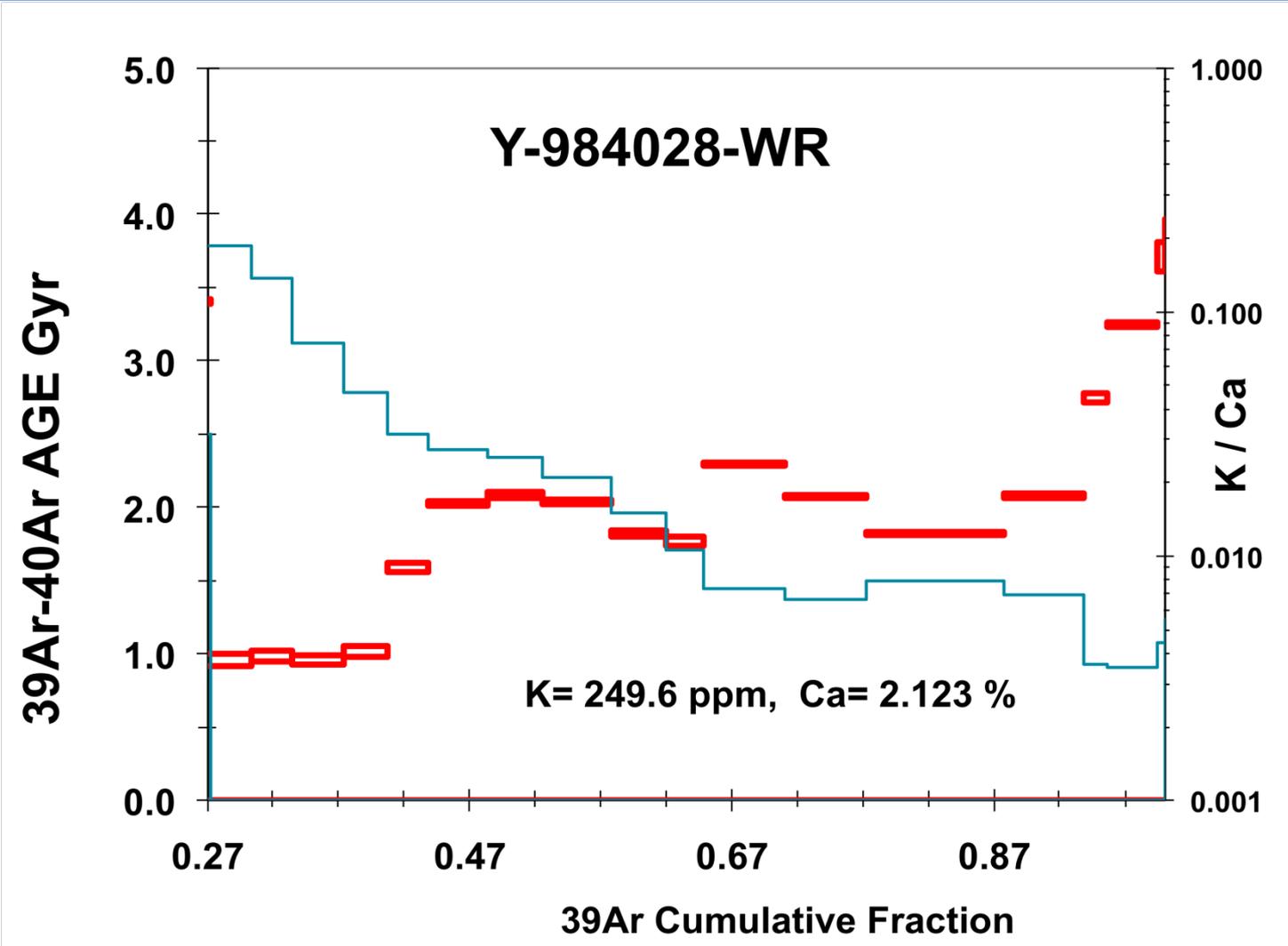
(Misawa et al., 2008; Bogard et al., 2009)



Sm-Nd age
 = 170 ± 10 Ma
 Rb-Sr age
 = 170 ± 9 Ma
 (Shih et al., 2010)

Ar-Ar age ~ 2 Ga;

Indicating multiple
 Ar components,
 radiogenic $^{40}\text{Ar}^*$,
 cosmogenic Ar &
 trapped Ar from
 different
 minerals/multiple
 source origins

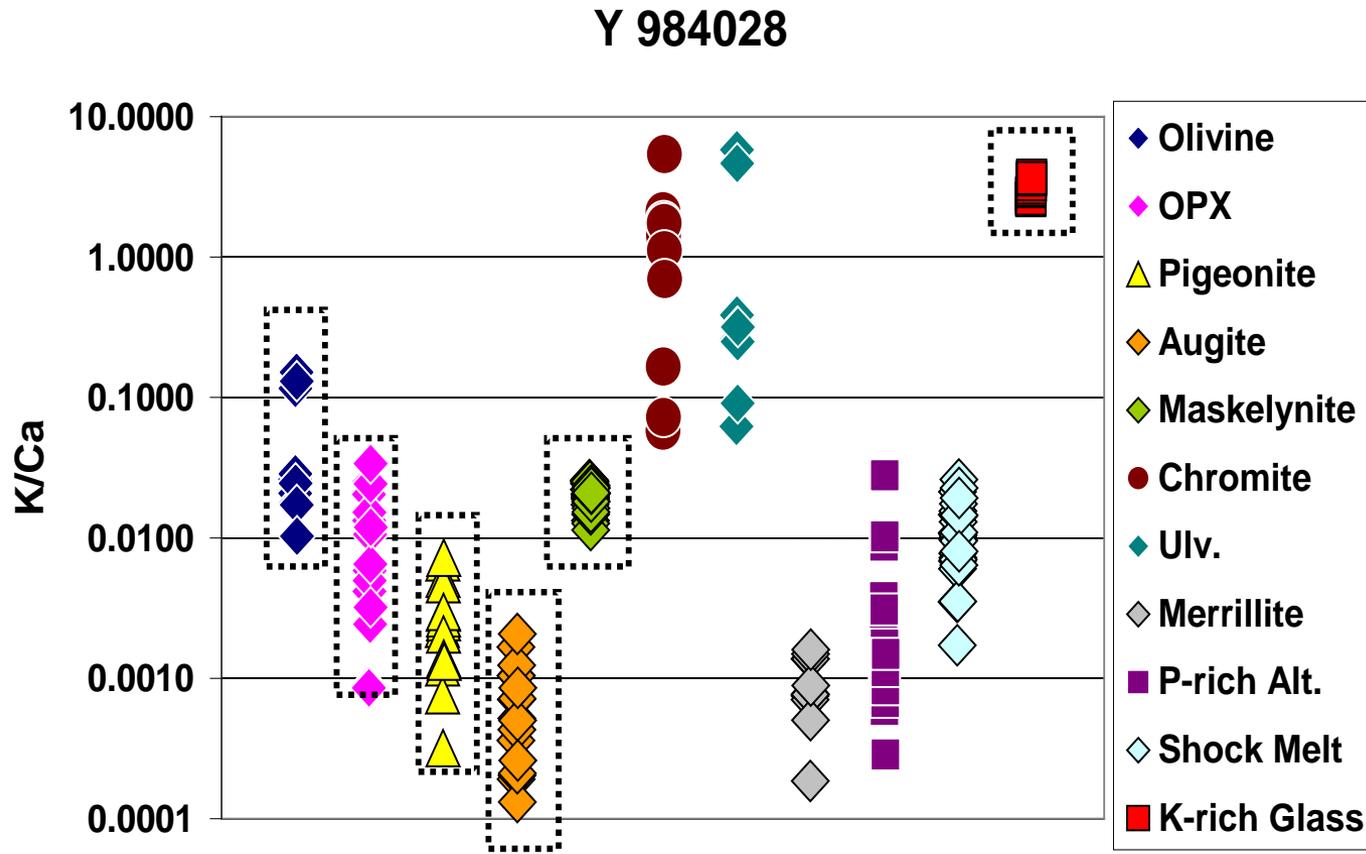


Sm-Nd age
= 170 ± 10 Ma

Rb-Sr age
= 170 ± 9 Ma
(Shih et al., 2010)

Ar-Ar age ~ 2 Ga;

Apparently, Ar-Ar ages of Y984028 show trapped Ar components

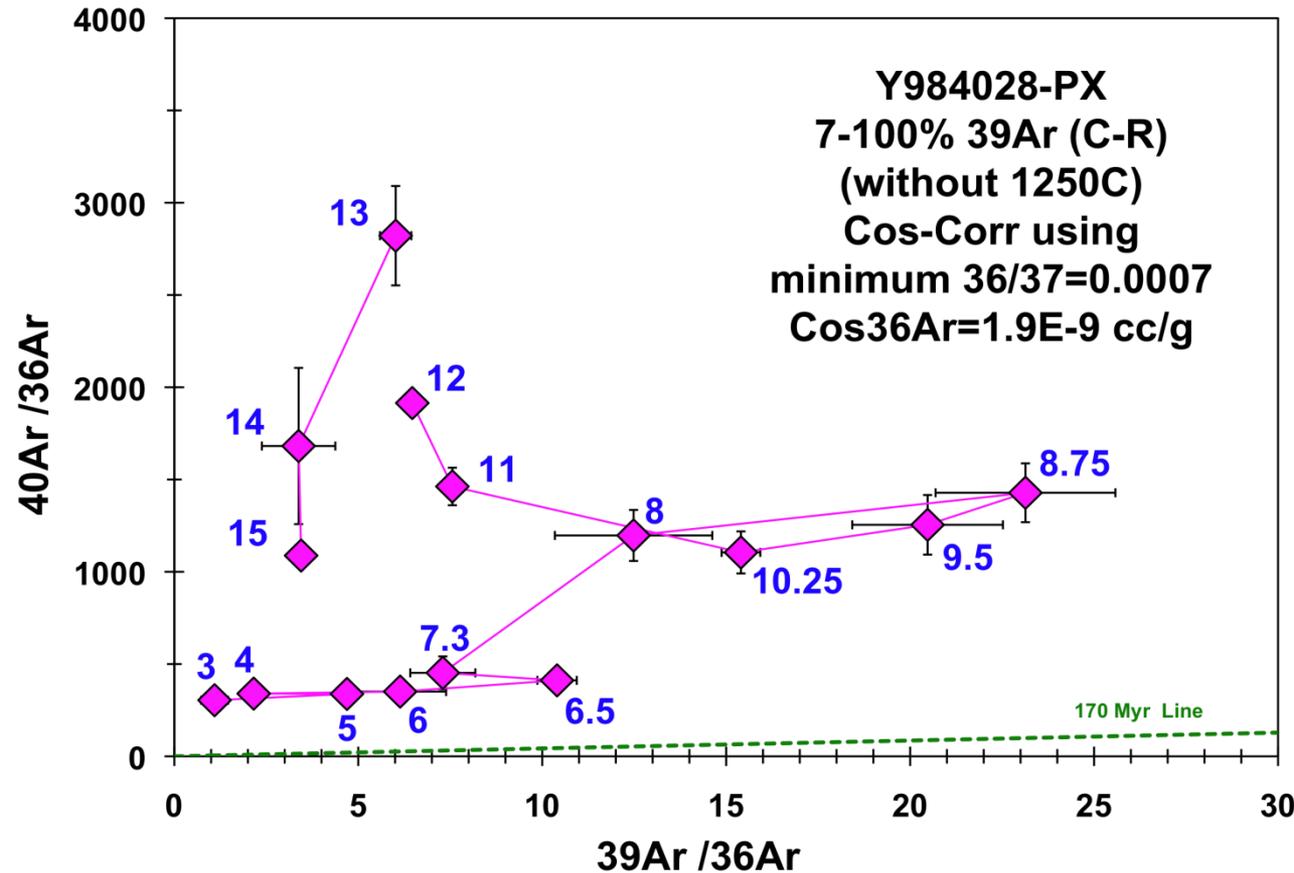


K/Ca determined by electron microprobe

Open boxes can be interpreted as multiple mineral phases in Ar-Ar whole rock data

K/Ca in Y984028 PX; Last 20% of ^{39}Ar release is OPX, Augite, first 80% is Plag (Mask)

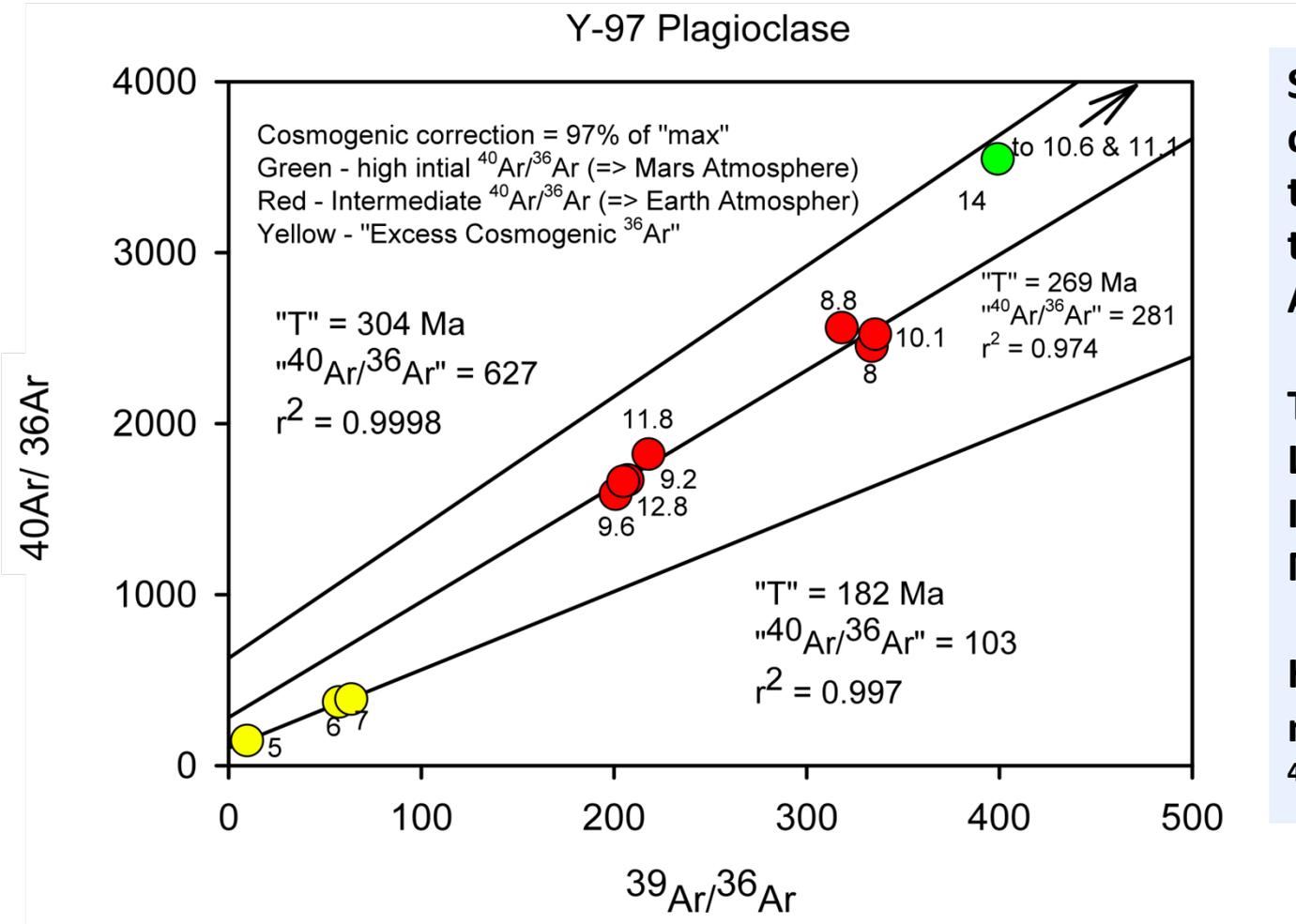
(Mikouchi, per. comm)



Nuclear Component:
 ^{37}Ar made in reactor from Ca;
 $\text{Cos-}^{36}\text{Ar}$ made in space from Ca.
 Expect nuclear ($^{36}\text{Ar}/^{37}\text{Ar}$) ratio to be constant.
 Identify ratio & use to correct for $\text{Cos-}^{36}\text{Ar}$

Estimated cosmogenic $^{36}\text{Ar} = 1.9 \times 10^{-9}$ cc/g
 (similar to 1.3×10^{-9} cc/g, Nagao, 2009).

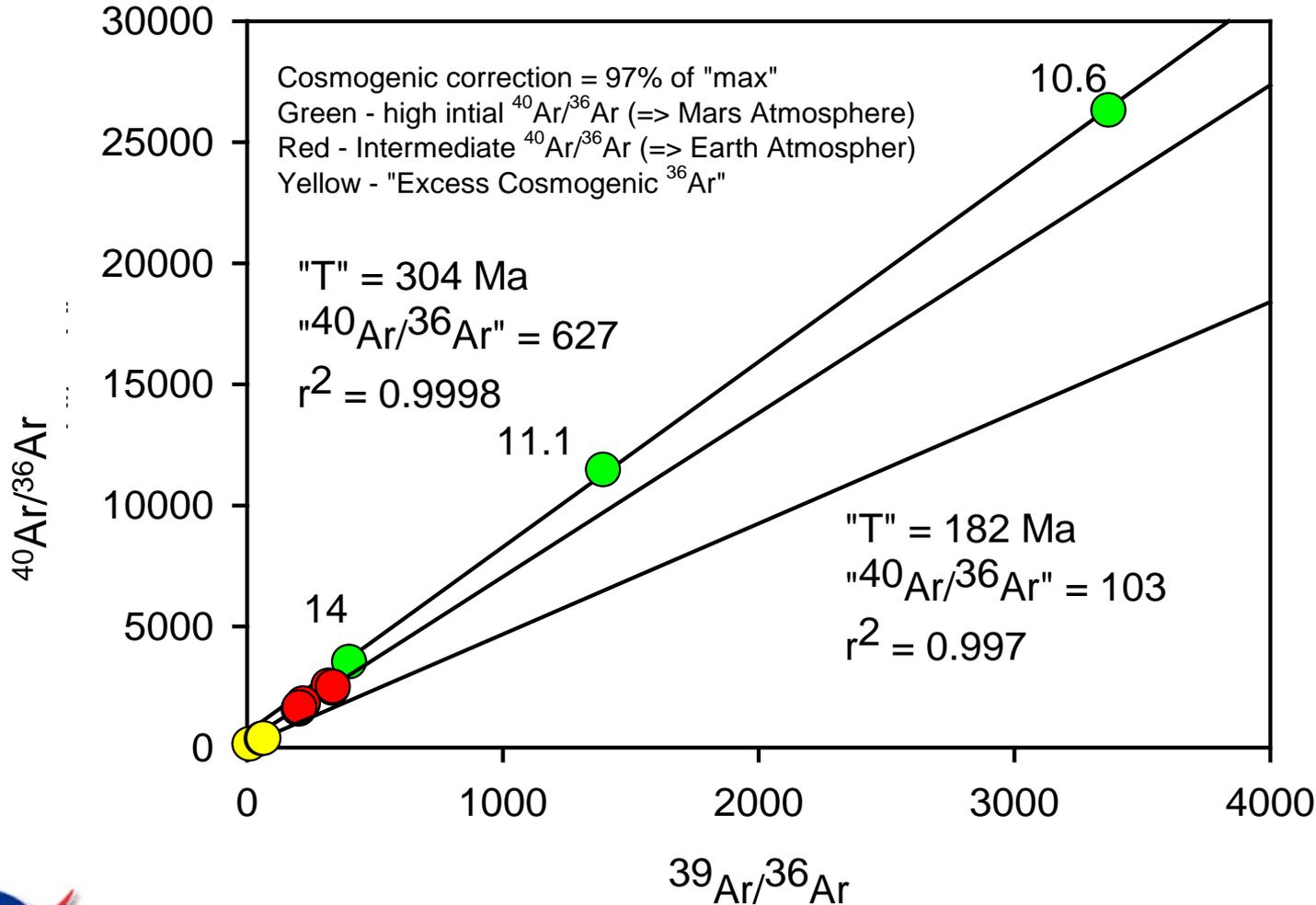
Lower temp: consistent with ~ 170 Ma (with $^{40}\text{Ar}/^{36}\text{Ar}$ of terrestrial atm (~296))
 Intermediate temp: consistent with ~170 Ma (high initial $^{40}\text{Ar}/^{36}\text{Ar}$ intercept)
 Higher temp: higher slope (px)



Show multiple Ar components; radiogenic, trapped Martian atm, terrestrial atm, inherited Ar.

Three isochron;
 Lower temp ~ 182 Ma
 Intermediate temp ~ 269 Ma (except 1060°C & 1110°C fraction)
 Higher temp-inherited, mantle Ar (higher initial $^{40}\text{Ar}/^{36}\text{Ar}$ ~ 627

Y-97 Plagioclase



- The ~ 170 Ma age of the rock(s) is (likely) preserved in minor phases of high K content
- Terrestrial Ar appears to have a nearly ubiquitous presence in the gas release, and mixes with Martian Ar in variable proportions.
- The intermediate temperature release of the plag separate shows an apparently higher ~ 270 Ma age, and suggests the presence of terrestrial Ar that “torques” the correlation to a steeper slope than for 170 Ma.
- The intermediate temperature data of the pyroxene is consistent with a “young” age (either ~ 170 to ~ 270 Ma) and mostly Martian trapped Ar.
- The low temperature (needs checking) data also are essentially consistent with the ~ 170 Ma age, but an intercept near the terrestrial value is suspicious.
 - Would not have had terrestrial Ar on Mars, so this is more likely a mixing line
- Admixtures of terrestrial Ar in the pyroxene extractions seems pervasive, but can’t explain the variation in 39/36 along the intermediate temp. “isochron”.